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NOTES ON THE FUNCTIONAL EXAMINATION OF THE EAR BY MEANS OF THE VOICE.

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THERE are several difficulties which prevent the regular use of the human voice in the testing of the hearing of aural patients. One of the least, perhaps—but certainly one—is the slowness with which suitable words suggest themselves to the surgeon when he has his patient sitting in a quiet room, prepared to repeat the words he hears.

It is not satisfactory to propose as tests the first words which occur to the mind, because some common words are easily recognised, whilst others are recognised only with difficulty. The different vowels and consonants of which words are made up vary so much in their perceptibility to the organ of hearing, that unless some arrangement be observed, it is not possible to obtain any clear idea of the hearing in the case under examination, and equally impossible to tabulate and compare the results arrived at.

For example, a relatively deaf man may hear the word "sash" quite well, while another man, not so deaf in reality, may fail to hear the word "rule" (both men being tested at the same distance from the examiner, and under the same conditions); for "sash" is one of the easiest words to recognise, while "rule" is one of the most difficult.

Clearly, then, it is necessary for the examiner to have some idea of the relative sound-value of the words he is proposing as tests, and to bring those words forward in some proper order.

Possibly some of your junior readers may have experienced, as I have, the difficulty of calling to mind suitable test-words in sufficient number while the patient is waiting. If any have, perhaps they will look kindly upon a short list of words which I have prepared for my own use, and which I propose setting down here.

I have drawn up the list on the basis of the teaching in Professor Politzer's clinic in Vienna, where, under the superintendence of the professor and his assistant, Dr. Gustav Alexander, both in-patients and out-patients are regularly tested by means of the human voice ; and the watch, which is so commonly used in this country, is discarded so far as air-conduction is concerned.

Sound-Values of Different Letters.

A.—Vowels.

1. Of the vowels, "a" (the German *a*,—long, as in English *alms*,—or shorter) has the greatest sound-value, being heard at the greatest distance of all, and always, if heard at all, being heard as *a*.

The other vowels follow in this order, the list ending with the vowel of least sound-value :—

2. German "i" (as in English *field*—long, or *milk*—short).
3. German "e" (as in English *share*, *shell*, *they*, &c.).
4. German "o" (as in English *stone*, or *off*),
5. German "u" (as in English *rule*, or *full*).

It is to be noticed, too, that as one approaches the limit, with the later of these vowels there are often mistakes made, even when the listener thinks he hears.

B.—Consonants.

Of the consonants, those having the "s" sounds are the best heard, including not only the sound of "s" in *sun*, but also that of "z" in *zeal*, and that of "sh" in *shell*. The consonants heard with the greatest difficulty are "r," "m," "n," "l." The remaining consonants occupy different positions intermediate between these two extremes.

If, then, a surgeon wishes to find the utmost limit

of his patient's power of hearing, he will propose to him words made up of these hardly-heard vowels and consonants ; for example, such words as *moan* or *own*. And he can find the limit in the other direction by uttering only words composed of "s's" and "a's," such as *sash*, *ass*, &c.

Midway between these extremes are what one may call "middle" or "mixed" words, in which the other vowels and consonants figure—"e," and "b," "k," "t," &c. These mixed words are perhaps the best adapted for trying first with average patients ; one of the other groups being employed if it is necessary to make the test more severe, or less, as the case may be.

Classification of Words.

I have arranged the test-words in three main groups :

I. Those most easily heard.

II. Those heard with the greatest difficulty.

III. Those intermediate in difficulty—mixed words.

I shall enlarge upon them in this order for convenience of description, although I have recommended above the use of the words belonging to Group III. first, Group I. or Group II. being used next, according as the patient's hearing is comparatively bad or good.

I. The first group of words contains—

(*a*) Those most easily heard, on account of their "s" and "a" sounds.

(*b*) Some a little less easily heard, having the "s" sound and the "i" (German "i") sound.

(*c*) Others a little more difficult to hear, having still the "s" sound, but, as vowel, the "e" (German "e") sound.

It will be observed that every word in this Group I. has only the easy "s" sound in its consonants ; and that—

Those in (*a*) have the vowel "a" sound alone.

Those in (*b*) have the vowel "i" sound, combined sometimes with the "a" sound in a separate syllable.

Those in (*c*) have the vowel "e" sound, combined sometimes with one of the two easier vowel-sounds above.

Group I.—(*a*) Ash – ass – sash – Shah.

(*b*) Ashes – ashy – easy – sea – she.

(*c*) Ace – Asia – assay – assess – chase – chess – essay – etch – say.

II. All the words in the second group contain the most difficult of the vowel-sounds, namely, "u," and one or more of the difficult consonants, "m," "n," "l," "r" :—Loo – loom – loon – lure – moo – moon – moor – noon – room – rue – rule – rumour – rune.

III. In the third group are the intermediate (middle or mixed) words, having one or more of the consonants, "b," "p," "k," "c" (hard "c"), "t," "d"; and also one of the vowel-sounds of medium difficulty. These words I have arranged further into three classes, each class containing words a little more difficult of recognition than those in the one preceding it :—

(*a*) Words having the medium vowel-sound "e";

(*b*) Words having the slightly easier vowel-sound "i";

(*c*) Words having the slightly harder vowel-sound "o."

(*a*) Ache – aid – ape – ate – bade – bait – bake – bay – cade – cake – cape – Kate – paid – pate – take – tape – Tate.

(*b*) Bead – beak – beat – bee – bib – bid – bit – Dick – did – dip – ditty – eat – keep – key – kid – kit – peat – pick – pip – pique – pit – tea – teak – teat – teed – tip – tit – Tydd.

(*c*) Boat – bob – bode – coat – cob – cock – cod – code – coke – cope – cot – dock – dot – dote – pock – pod – poke – pop – pope – pot – toad – tod – toe – top – tope – toque – tot.

It is obvious that mixed words are the most plentiful, And they are the most important, for, of course, they approach most nearly in their sound-values to ordinary speech, which is what the patient probably most wishes to hear.

Other mixed words of considerable value are numerals. But simple words, such as appear in this list, have the great advantage that the whole word must be heard before the patient can repeat it ; in the case of polysyllabic words it is often possible to recognise, in its entirety, a word of which various letters have been missed. And, further, the ability to repeat a long word depends in part upon the strength of the memory, and such a word is not therefore a pure test of hearing.

The Examination in Practice.

A few notes on the actual examination of the hearing by means of the human voice, as practised by Professor Politzer and his assistants, may be acceptable to some

of the junior surgeons who are desirous of employing the method.

The patient sits or stands in a quiet room, with one ear, usually the right to begin with, turned to the surgeon. The other ear is closed by the insertion of a finger-tip, which is more efficient if it is first dipped in water. So placed, the patient cannot see the examiner's mouth as he pronounces the test-words, and so he gets no help in the recognition of the words from any ability in lip-reading he may possess ; and the stopped ear is excluded from examination. Excluded, that is, as far as possible—for one cannot exclude one ear absolutely. The surgeon may test himself as to this. If, having normal hearing on both sides, he close both ears as firmly as possible, he can yet hear conversation at about a yard's distance. The explanation of this is that sounds are conducted, not only from the external meatus to the internal ear, but also from the nose by means of the Eustachian tube to the middle ear and thence to the internal ear, and also from one internal ear to the other across the skull. This impossibility of excluding one ear absolutely has to be borne in mind, especially in the examination of patients who have one very good ear and one very deaf one. In such cases the test is more satisfactory if it is conducted through the speaking-tube, for this excludes the second ear from the examination more completely than when the moistened finger is used alone.

These preliminaries having been arranged, the patient is directed to repeat aloud, and at once, the words which he hears uttered.

First, then, the surgeon may test with his ordinary conversational voice (C V.). Beginning at a distance of, say, two yards, and addressing himself directly to the ear under examination, he pronounces, distinctly, of course, one of the " mixed " words of Group III. If the patient hears it, and repeats it, the surgeon goes farther away, and pronounces another such word, and so continues, moving gradually farther and farther away, until he reaches a point at which the patient fails to repeat correctly the word uttered. At this distance, one or two words may be tried, so as to make quite sure of the patient's helplessness, but it is better not to repeat any one word, which has not been recognised, more than once, but rather to change to another.

If the room in which the examination is being conducted is not large enough to permit of the limit's being reached in this way, the surgeon may turn his back to the patient, and, standing a yard from the further wall, may address the words to the wall. This is called the "half-turn." If still the patient hears, *he* also may be turned round, so that the ear under examination is turned away from the surgeon, and directed to the wall, from which it is one yard distant; and then, standing himself in the "half-turn" position, the surgeon may pronounce his test-words again. This is called the "full-turn."

The distances under these circumstances are reckoned thus:—The distance of the voice in the "half-turn" position is equal to the full distance of the patient from the surgeon, plus one-third of the full distance. For example, if the room is eleven yards long, and the patient sits one yard from the wall, and the surgeon stands one yard from the opposite wall, nine yards is the full distance between them. Then the distance in the "half-turn" is reckoned as nine yards, plus a third of nine yards (nine plus three), or twelve yards. In a similar manner, the distance in the "full-turn" position is reckoned as the full distance, plus *two*-thirds of the full distance; in this example, therefore, it is nine plus six, or fifteen yards.

Of course, one need not press the examination with the mixed words to this extent; but, having found that they are heard at the full length of the room, the examiner may have recourse to the difficult words of Group II.

On the other hand, if the mixed words are not heard at the two yards' distance at which the examination began, one may at once make use of the easy words of Group I. Or he may approach nearer to the patient than two yards, still using the mixed words, until he finds a position from which they can be heard.

The right ear having been thus tested, the left is examined in exactly the same way.

Next, both ears should be tested together, the patient thus being in his natural and everyday condition. This is of more practical than scientific importance. For it sometimes happens that a patient complains of subjective noises, and yet only hears them when both ears are open; if, then, one ear be closed,

he may hear better, for the noises are not present to distract him. The binaural examination is best done by letting the patient (standing or sitting) face the surgeon, and look at his feet while being tested.

After the conversational voice, the whispering voice (W. V.) should be employed. Properly speaking, whispering is "articulation without voice," so that exact whispering is not really audible. In practice, however, "very little" voice is used as the whispering voice.

This part of the examination is conducted just as that with the conversational voice was—first the right ear, second the left ear, and last both ears together.

It is not possible to state exactly the normal hearing-distance of the voice, either conversational or whispering, for it depends largely upon the place and conditions of examination. But the average distance of the conversational voice is said to be normally about fifty-four yards; and that of the whispering voice about twenty-five yards.

If the patient hears so badly that even the easy words of Group I. are not perceived, the surgeon must try more violent means of irritating the aural apparatus.

3. He may try a stronger or "over-loud" voice, articulating with forced expiration. If this is not heard, he must use—

4. Consonants or vowels alone; or, failing their perception,

5. Strong noises and shouts.

This examination being completed, and before one takes up the tuning-forks, Politzerisation or catheterisation should be practised. Then the hearing should be tested again as before.

If the distance at which the words are now heard be distinctly and clearly increased, as from one yard to three, or twenty yards to fifty, it is right to hold that improvement has occurred. An increase of fifty yards to sixty, however, would not justify one in thinking that there was improvement. The surgeon must be on his guard, also, against thinking he has improved the hearing in a given case, when the apparent improvement is due to the patient's having become accustomed to his voice, and so recognising the words more easily. It is, by the way, to the conversational voice that improvement is usually most marked.